FIG. 1

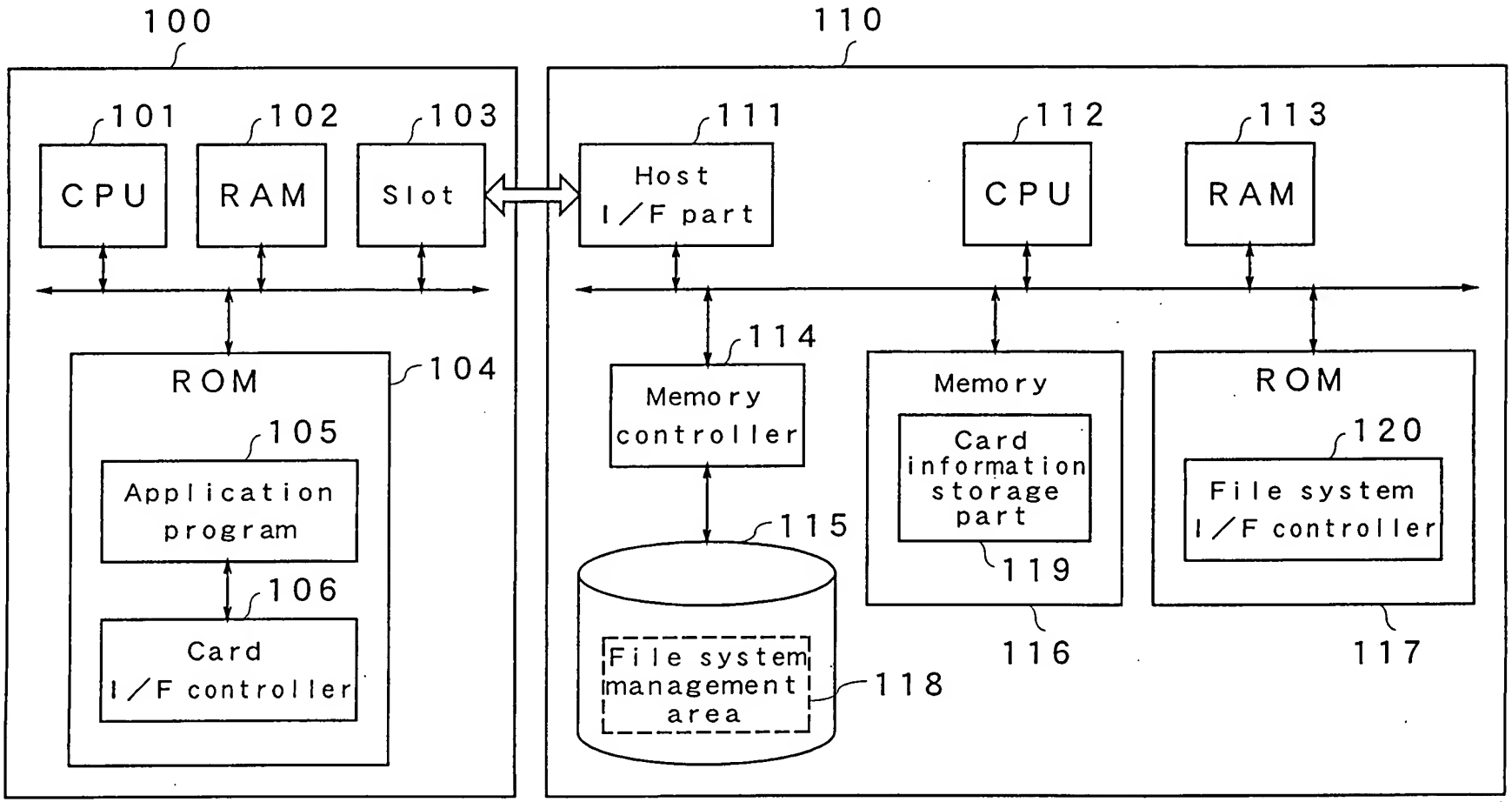

100
110
101
102
103
CPU
RAM
Slot
111
Host
I/F part
112
CPU
113
RAM
ROM
104
105
Application
program
106
Card
I/F controller
114
Memory
controller
115
File system
management
area
118
Memory
Card
information
storage
part
119
116
ROM
120
File system
I/F controller
117

FIG. 2

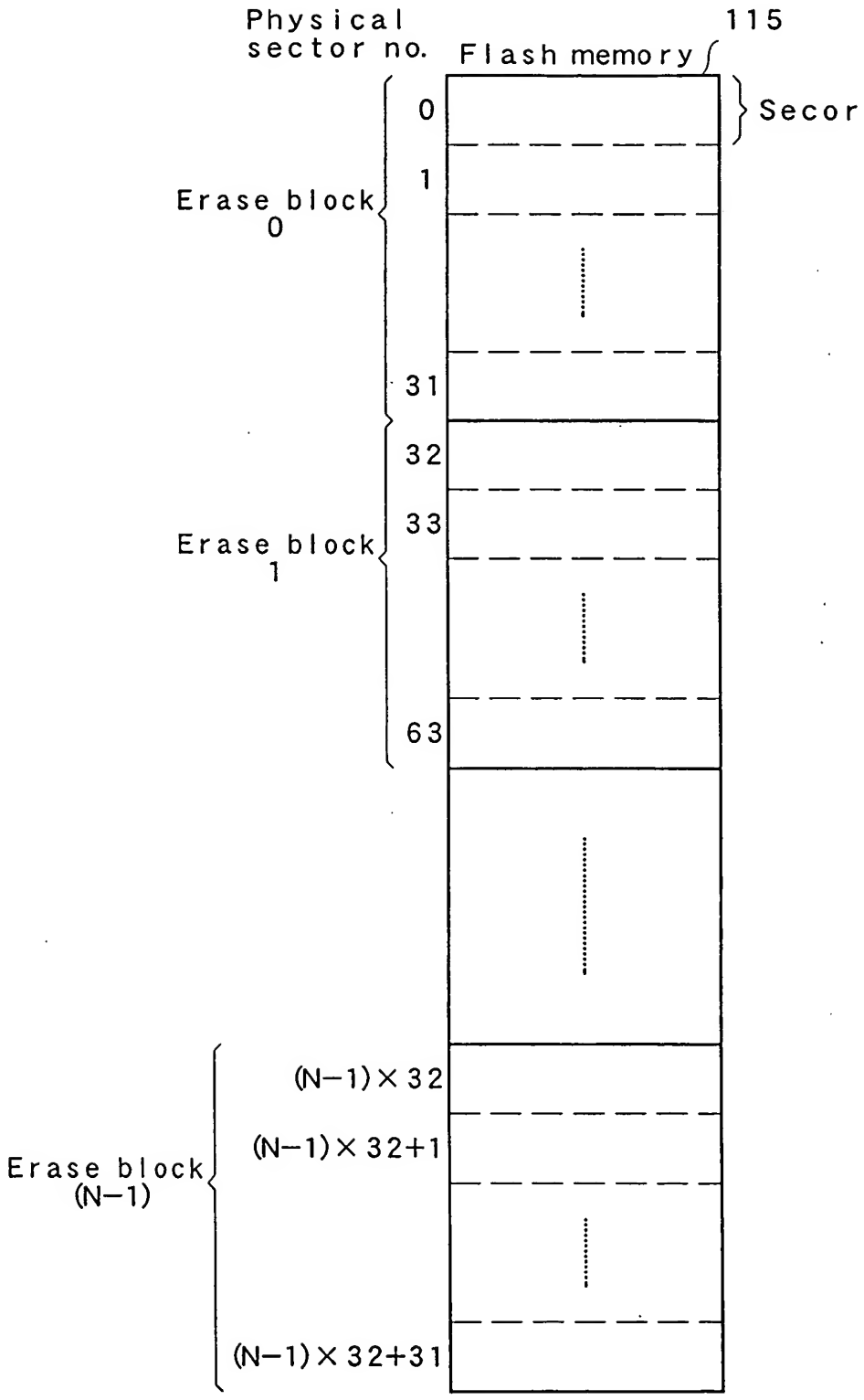

Physical sector no.
115
Flash memory
Secor
0
1
31
32
33
63
Erase block 0
Erase block 1
(N−1)×32
(N−1)×32+1
(N−1)×32+31
Erase block (N−1)

FIG. 3

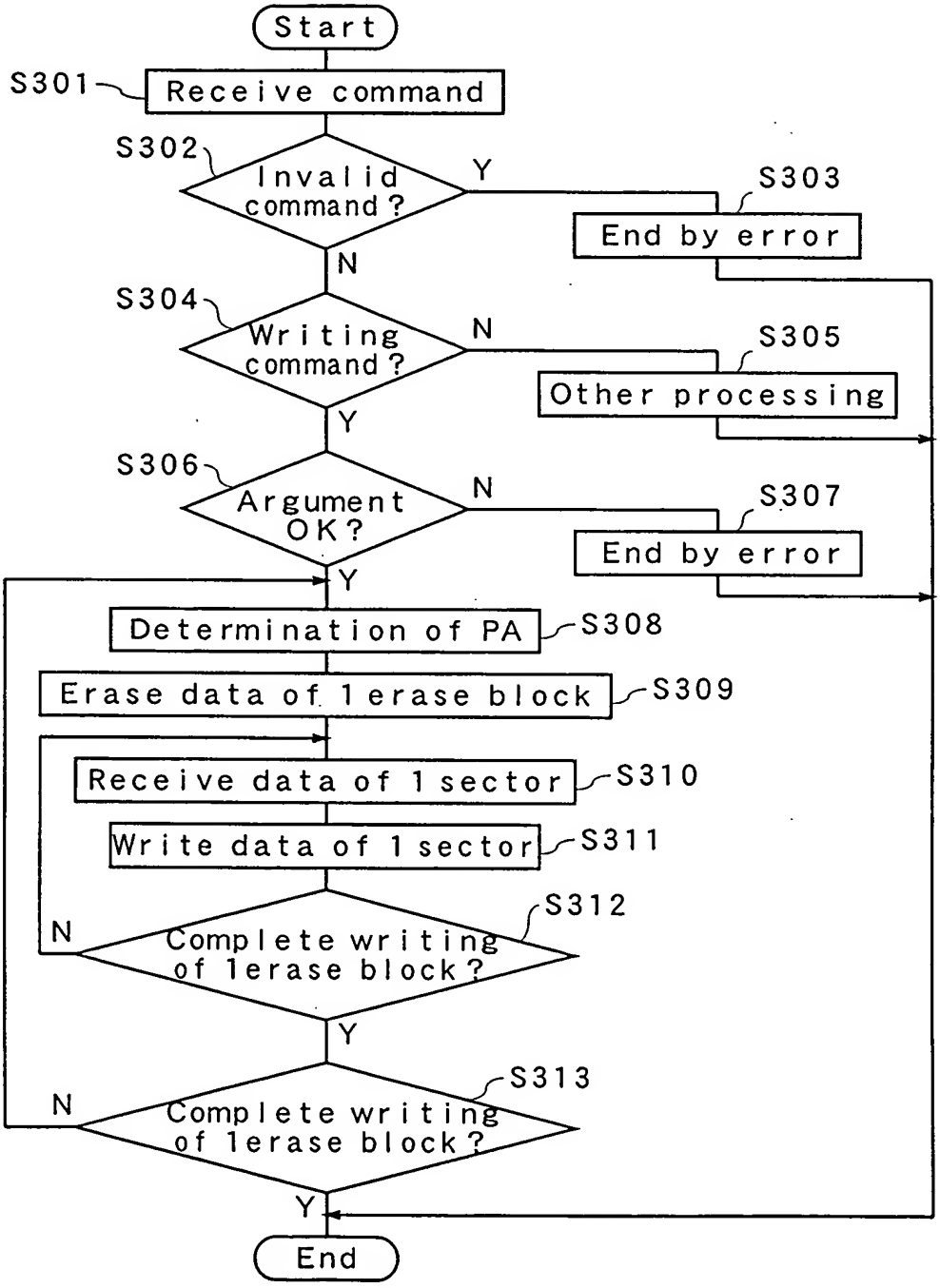

Start
S301
Receive command
S302
Invalid command?
Y
S303
End by error
N
S304
Writing command?
N
S305
Other processing
Y
S306
Argument OK?
N
S307
End by error
Y
Determination of PA
S308
Erase data of 1 erase block
S309
Receive data of 1 sector
S310
Write data of 1 sector
S311
S312
N
Complete writing of 1 erase block?
Y
S313
N
Complete writing of 1 erase block?
Y
End

FIG. 4

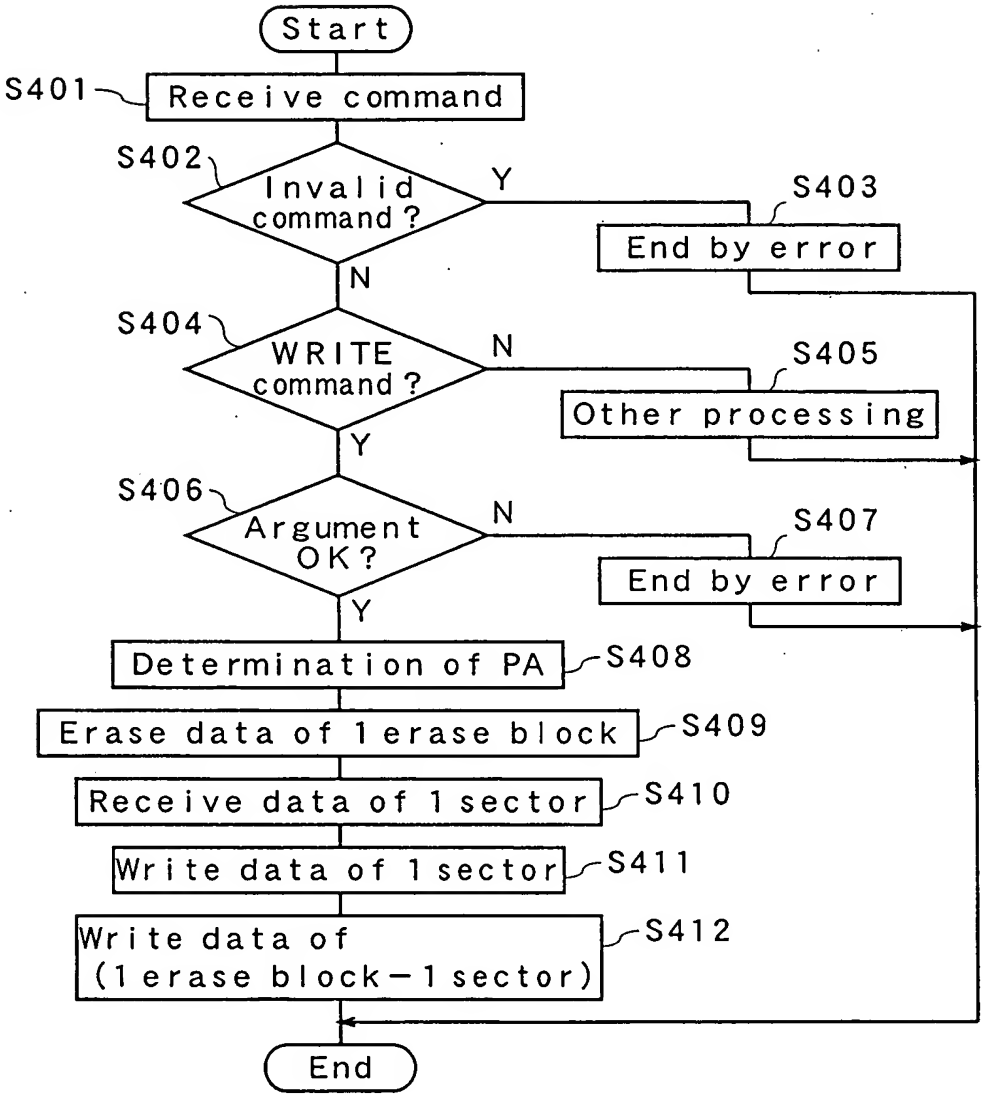

Start
S401
Receive command
S402
Invalid command?
Y
S403
End by error
N
S404
WRITE command?
N
S405
Other processing
Y
S406
Argument OK?
N
S407
End by error
Y
Determination of PA
S408
Erase data of 1 erase block
S409
Receive data of 1 sector
S410
Write data of 1 sector
S411
Write data of (1 erase block − 1 sector)
S412
End

FIG. 5

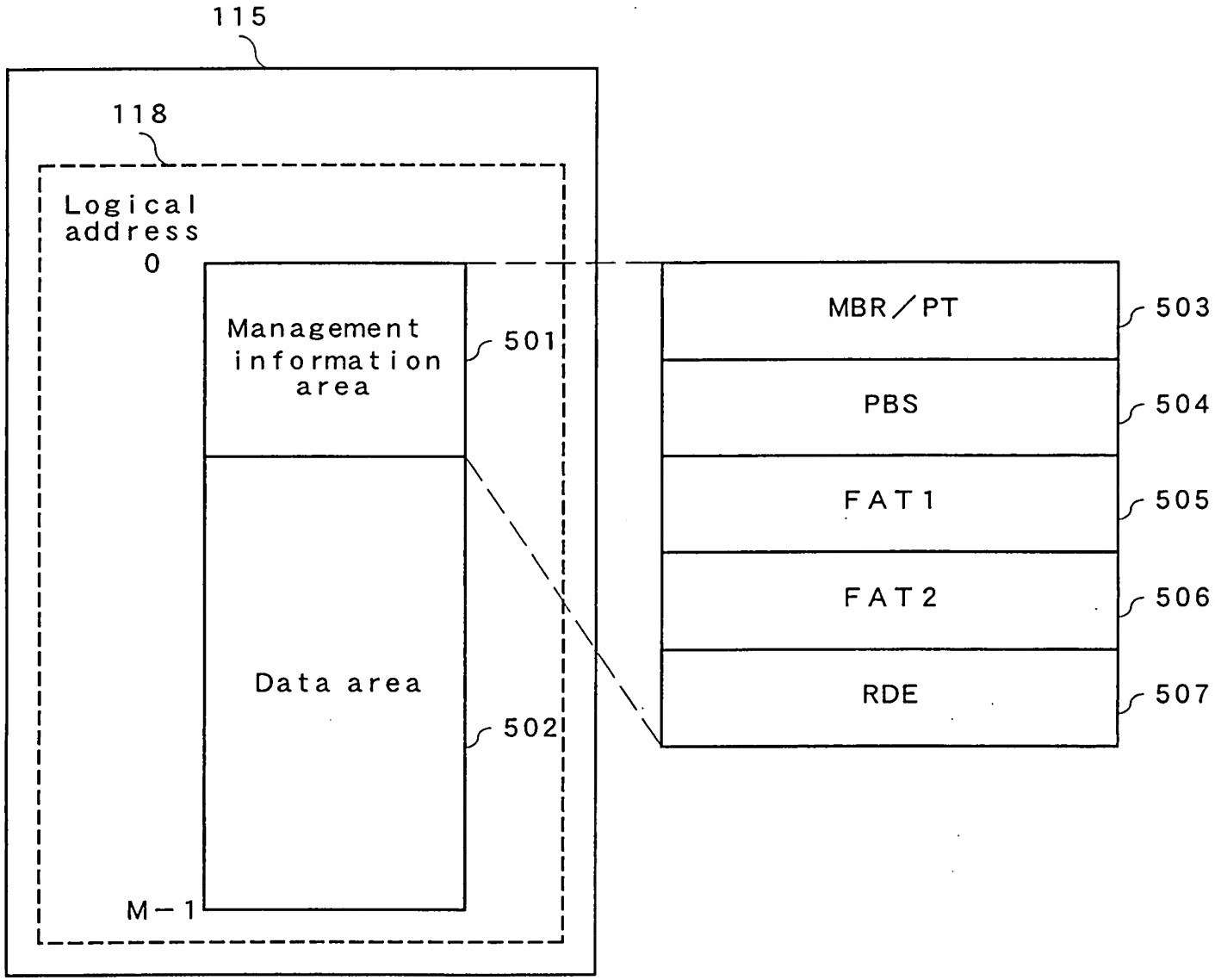

115
118
Logical address 0
Management information area
501
Data area
502
M−1
MBR／PT
503
PBS
504
FAT1
505
FAT2
506
RDE
507

FIG. 6

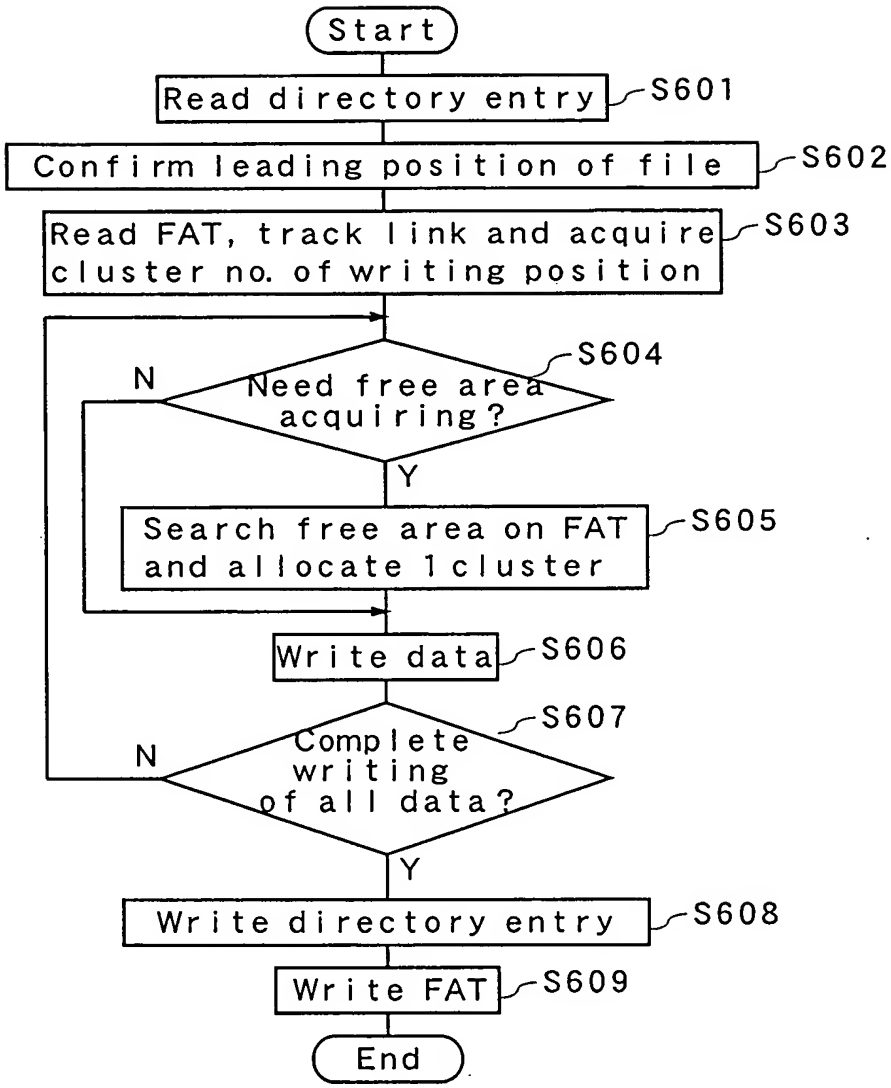

Start
Read directory entry
S601
Confirm leading position of file
S602
Read FAT, track link and acquire cluster no. of writing position
S603
Need free area acquiring?
S604
N
Y
Search free area on FAT and allocate 1 cluster
S605
Write data
S606
Complete writing of all data?
S607
N
Y
Write directory entry
S608
Write FAT
S609
End

FIG. 7

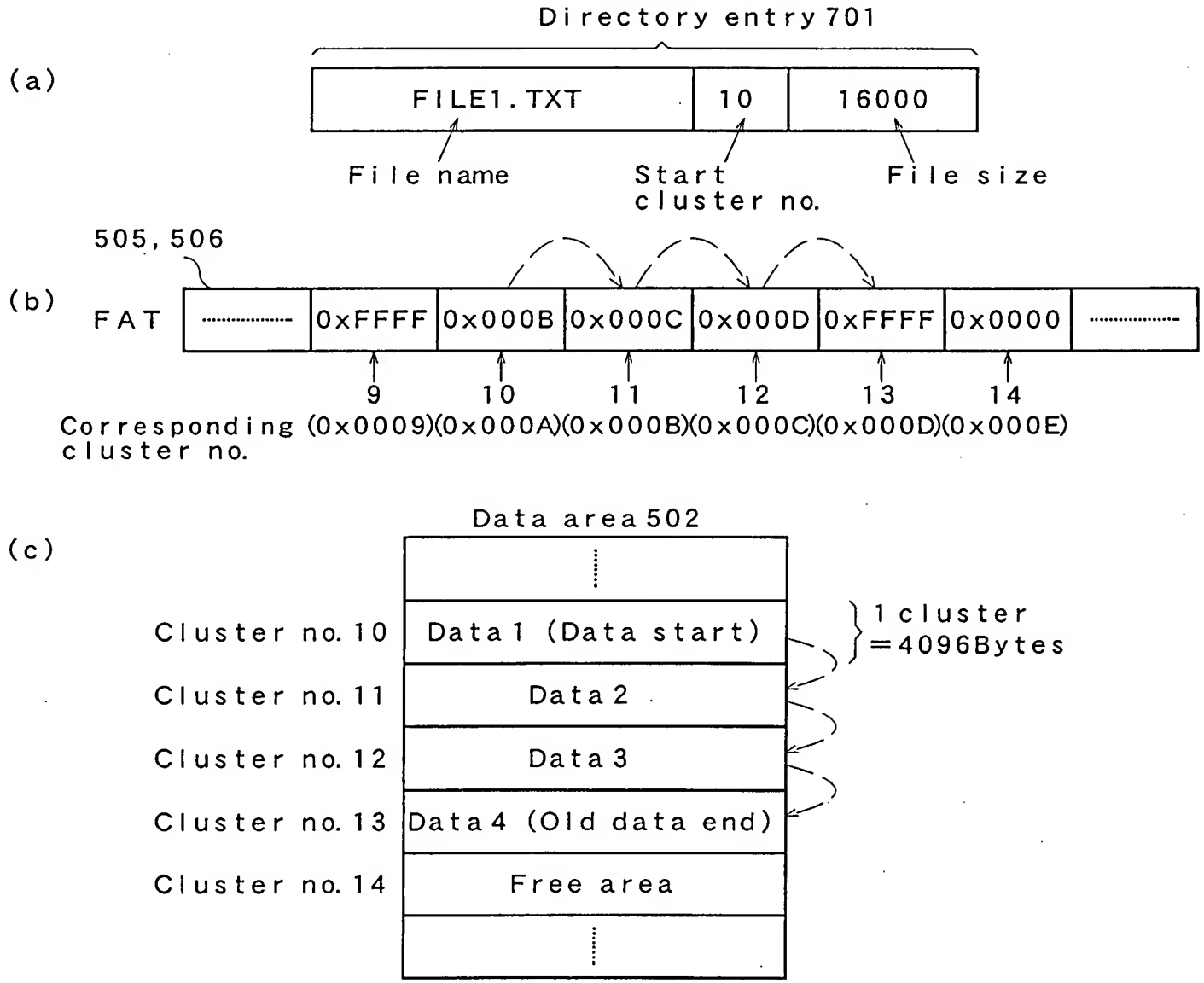

Directory entry 701
(a)
FILE1.TXT
10
16000
File name
Start cluster no.
File size
505, 506
(b)
FAT
0xFFFF
0x000B
0x000C
0x000D
0xFFFF
0x0000
9
10
11
12
13
14
Corresponding cluster no.
(0x0009)(0x000A)(0x000B)(0x000C)(0x000D)(0x000E)
Data area 502
(c)
Cluster no. 10
Data 1 (Data start)
Cluster no. 11
Data 2
Cluster no. 12
Data 3
Cluster no. 13
Data 4 (Old data end)
Cluster no. 14
Free area
1 cluster
=4096Bytes

FIG. 8

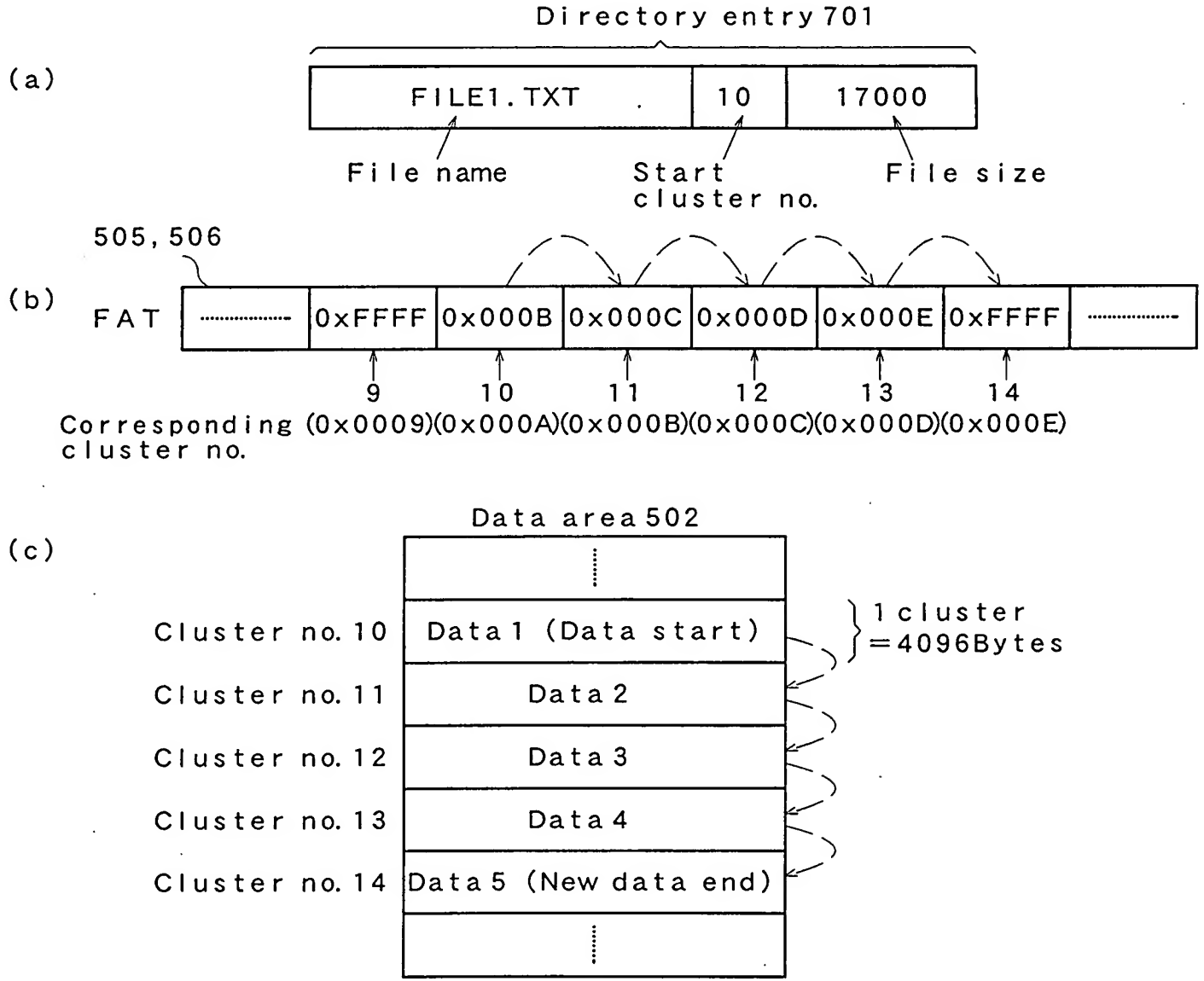

Directory entry 701
(a)
FILE1.TXT
10
17000
File name
Start cluster no.
File size
505, 506
(b)
FAT
0xFFFF
0x000B
0x000C
0x000D
0x000E
0xFFFF
9
10
11
12
13
14
Corresponding cluster no.
(0x0009)(0x000A)(0x000B)(0x000C)(0x000D)(0x000E)
Data area 502
(c)
Cluster no. 10
Data 1 (Data start)
Cluster no. 11
Data 2
Cluster no. 12
Data 3
Cluster no. 13
Data 4
Cluster no. 14
Data 5 (New data end)
1 cluster
=4096Bytes

FIG. 9

File system API	Items
OPEN	Open file
CLOSE	Close file
READ	Read data from file
WRITE	Write data to file
SEEK	Change current ref. position in file
DELETE	Delete file
RENAME	Change file name and directory name
MKDIR	Create directory
RMDIR	Delete directory
OPENDIR	Open directory
CLOSEDIR	Close directory
READDIR	Read data from directory
SEEKDIR	Change current ref. position in directory
FORMAT	Logically format file system

FIG. 10

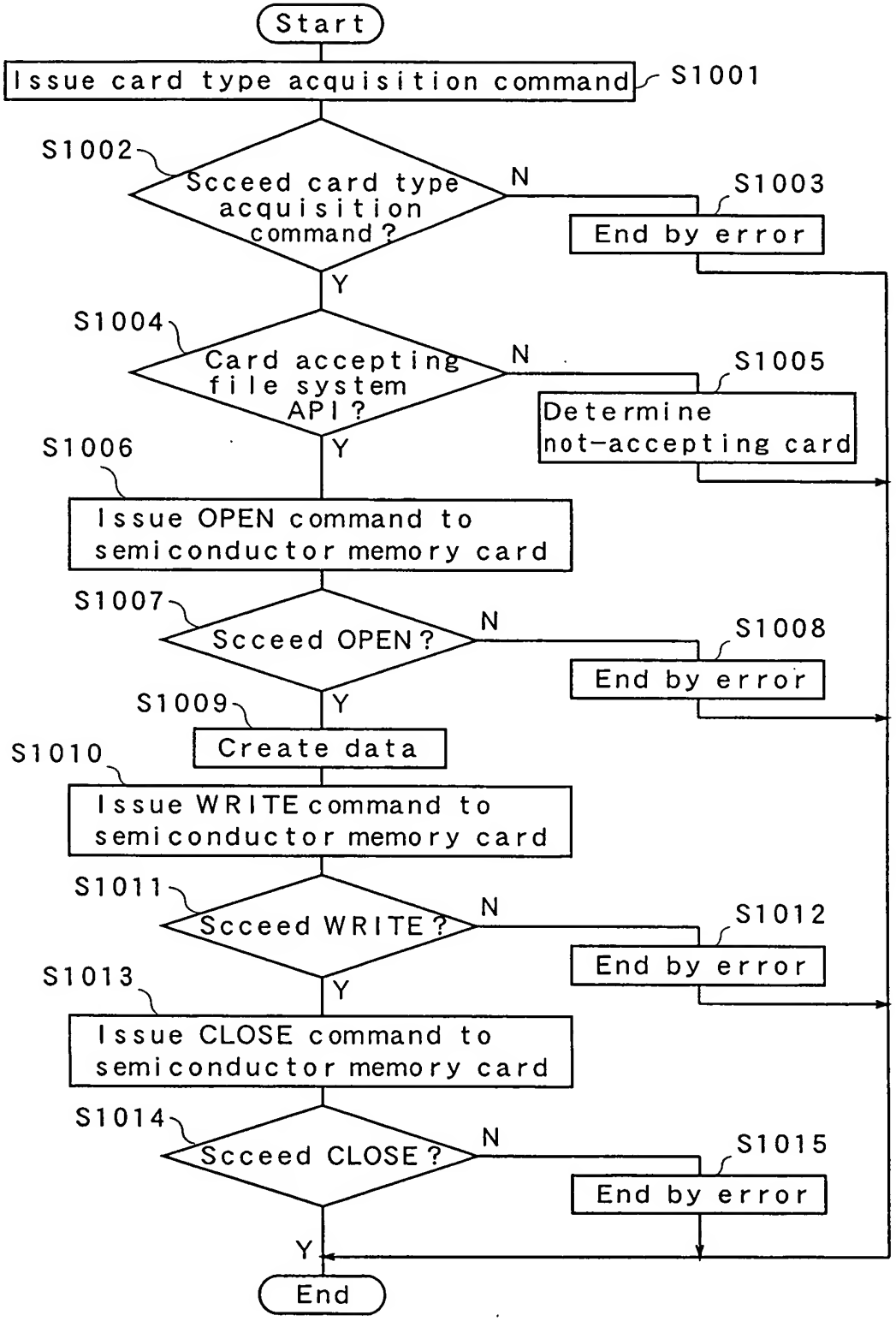

Start
Issue card type acquisition command
S1001
S1002
Scceed card type acquisition command?
N
S1003
End by error
Y
S1004
Card accepting file system API?
N
S1005
Determine not-accepting card
Y
S1006
Issue OPEN command to semiconductor memory card
S1007
Scceed OPEN?
N
S1008
End by error
Y
S1009
Create data
S1010
Issue WRITE command to semiconductor memory card
S1011
Scceed WRITE?
N
S1012
End by error
Y
S1013
Issue CLOSE command to semiconductor memory card
S1014
Scceed CLOSE?
N
S1015
End by error
Y
End

FIG. 11

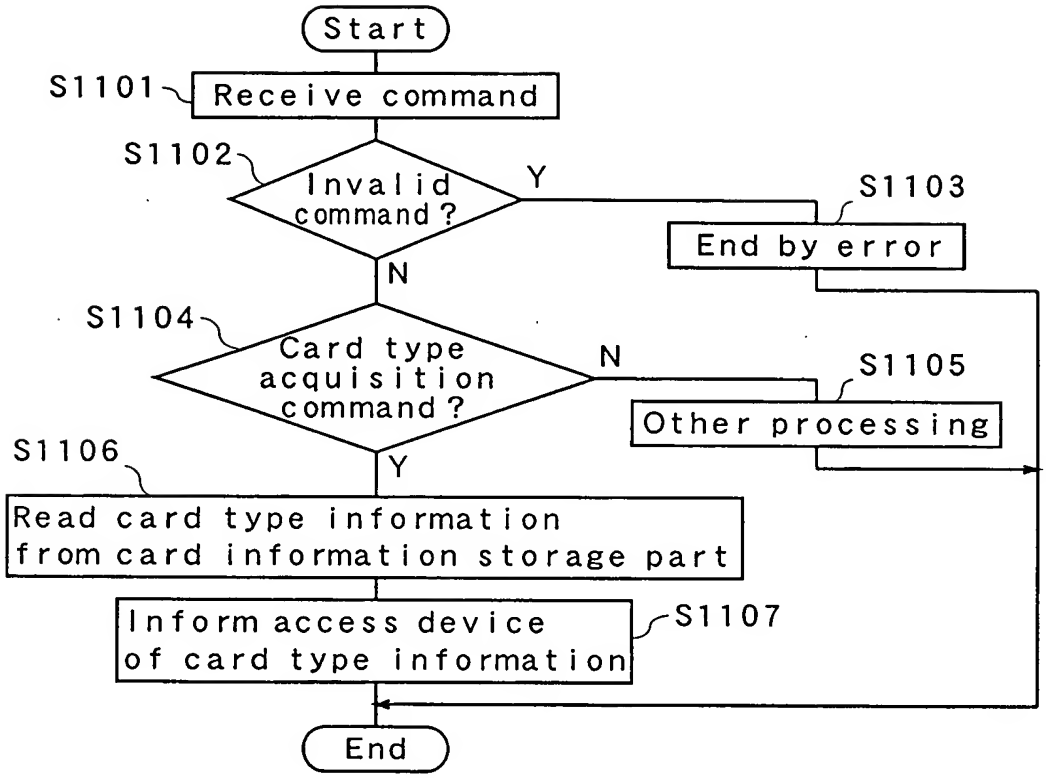

Start
S1101
Receive command
S1102
Invalid command?
Y
S1103
End by error
N
S1104
Card type acquisition command?
N
S1105
Other processing
Y
S1106
Read card type information from card information storage part
Inform access device of card type information
S1107
End

FIG. 12

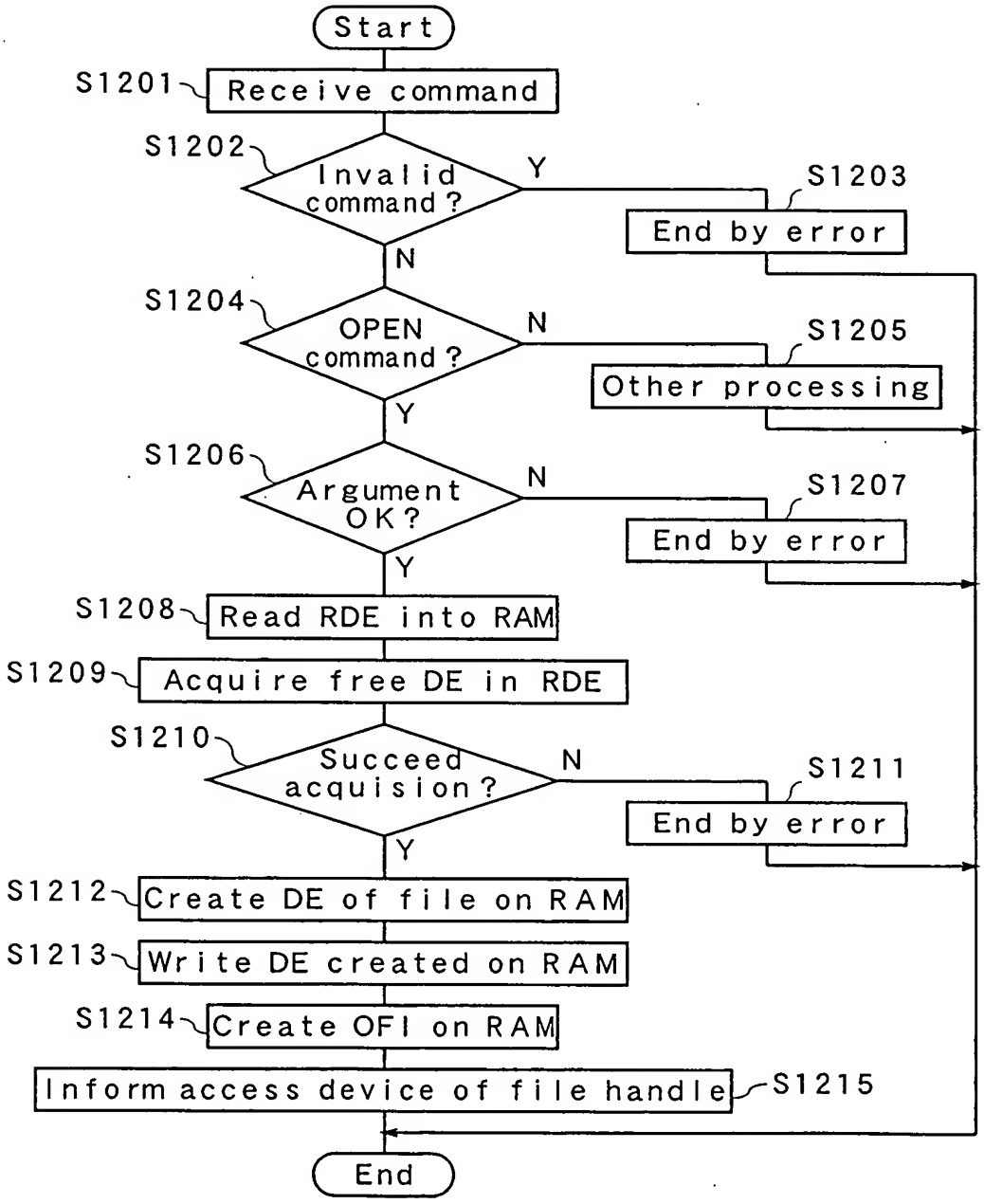

Start
S1201
Receive command
S1202
Invalid command?
Y
S1203
End by error
N
S1204
OPEN command?
N
S1205
Other processing
Y
S1206
Argument OK?
N
S1207
End by error
Y
S1208
Read RDE into RAM
S1209
Acquire free DE in RDE
S1210
Succeed acquision?
N
S1211
End by error
Y
S1212
Create DE of file on RAM
S1213
Write DE created on RAM
S1214
Create OFI on RAM
Inform access device of file handle
S1215
End

FIG. 13

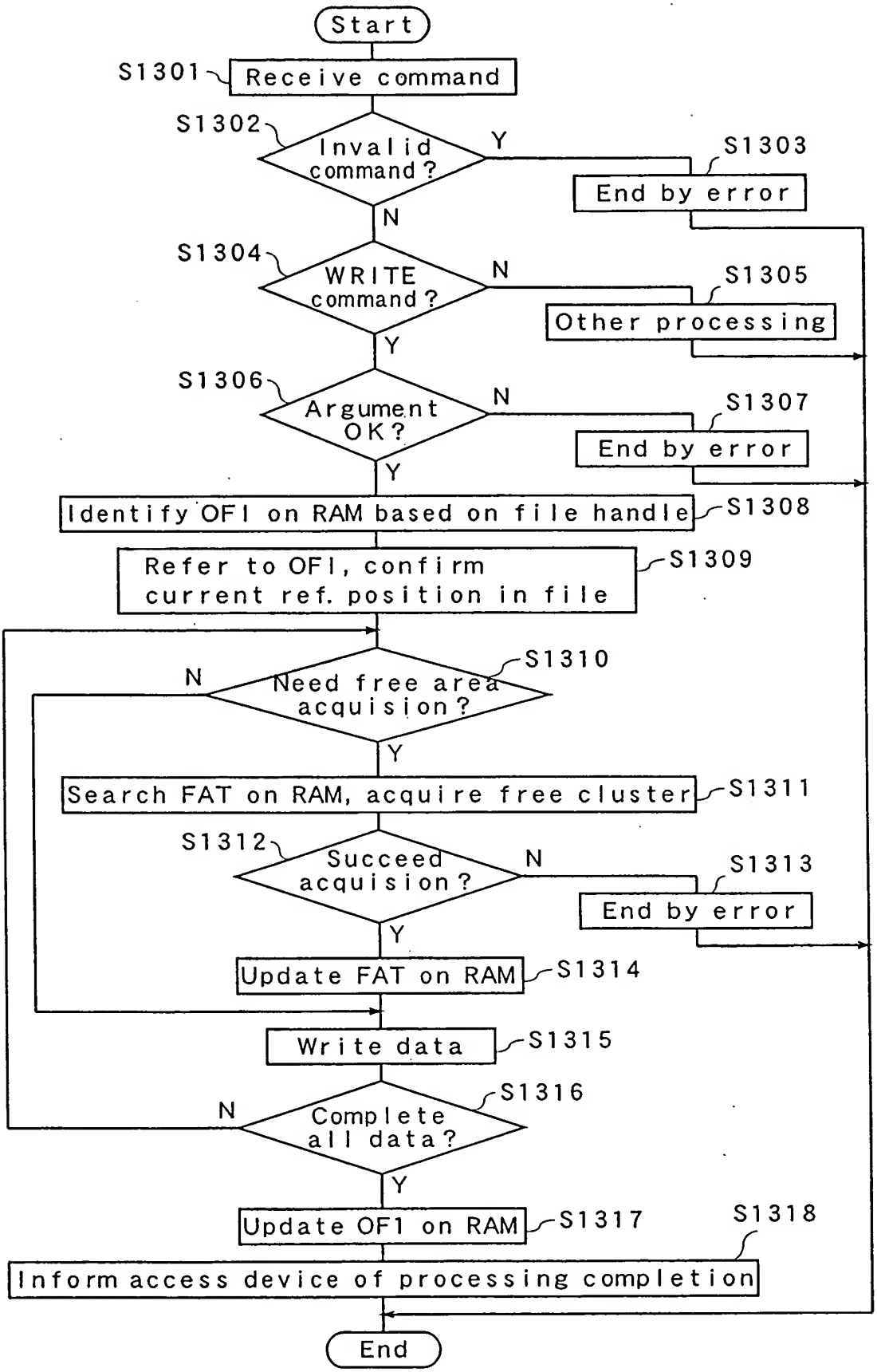

Start
S1301
Receive command
S1302
Invalid command?
Y
S1303
End by error
N
S1304
WRITE command?
N
S1305
Other processing
Y
S1306
Argument OK?
N
S1307
End by error
Y
Identify OFI on RAM based on file handle
S1308
Refer to OFI, confirm current ref. position in file
S1309
S1310
N
Need free area acquision?
Y
Search FAT on RAM, acquire free cluster
S1311
S1312
Succeed acquision?
N
S1313
End by error
Y
Update FAT on RAM
S1314
Write data
S1315
S1316
N
Complete all data?
Y
Update OF1 on RAM
S1317
S1318
Inform access device of processing completion
End

FIG. 14

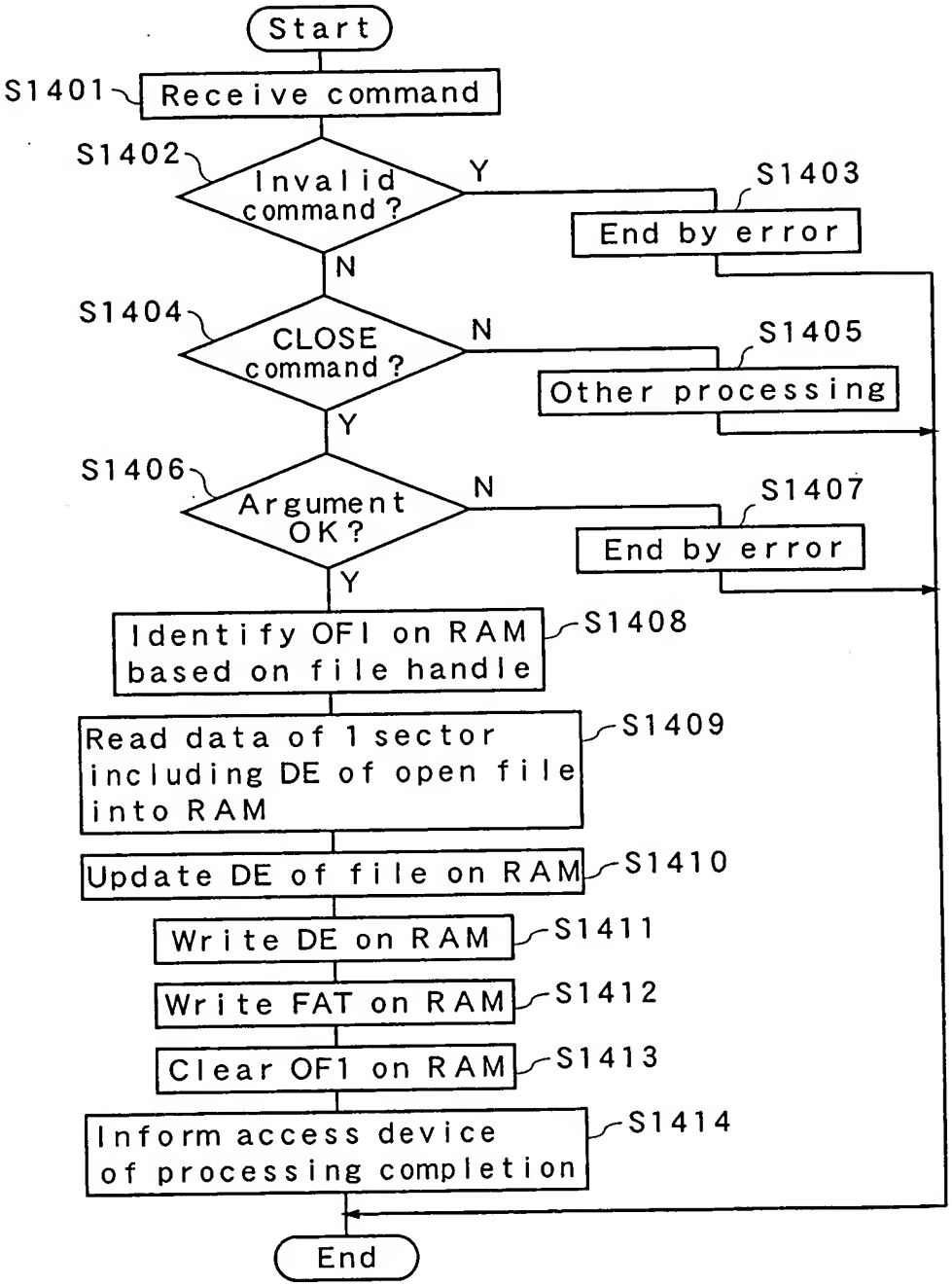

Start
S1401
Receive command
S1402
Invalid command?
Y
S1403
End by error
N
S1404
CLOSE command?
N
S1405
Other processing
Y
S1406
Argument OK?
N
S1407
End by error
Y
Identify OFI on RAM based on file handle
S1408
Read data of 1 sector including DE of open file into RAM
S1409
Update DE of file on RAM
S1410
Write DE on RAM
S1411
Write FAT on RAM
S1412
Clear OF1 on RAM
S1413
Inform access device of processing completion
S1414
End

FIG. 15

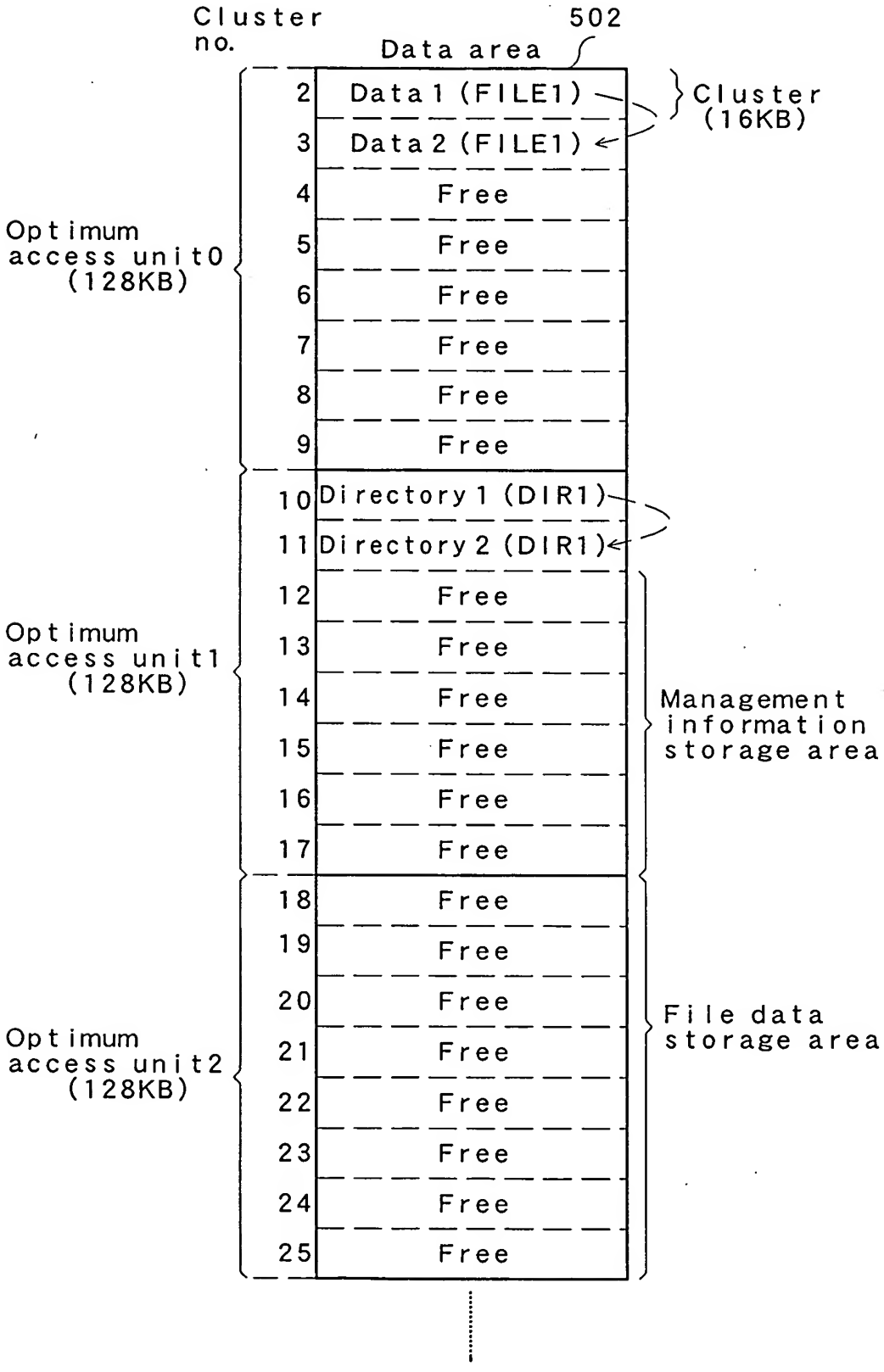

Cluster no.
502
Data area
2
Data 1 (FILE1)
3
Data 2 (FILE1)
Cluster (16KB)
4
Free
5
Free
6
Free
7
Free
8
Free
9
Free
Optimum access unit0 (128KB)
10
Directory 1 (DIR1)
11
Directory 2 (DIR1)
12
Free
13
Free
14
Free
15
Free
16
Free
17
Free
Optimum access unit1 (128KB)
Management information storage area
18
Free
19
Free
20
Free
21
Free
22
Free
23
Free
24
Free
25
Free
Optimum access unit2 (128KB)
File data storage area

FIG. 16

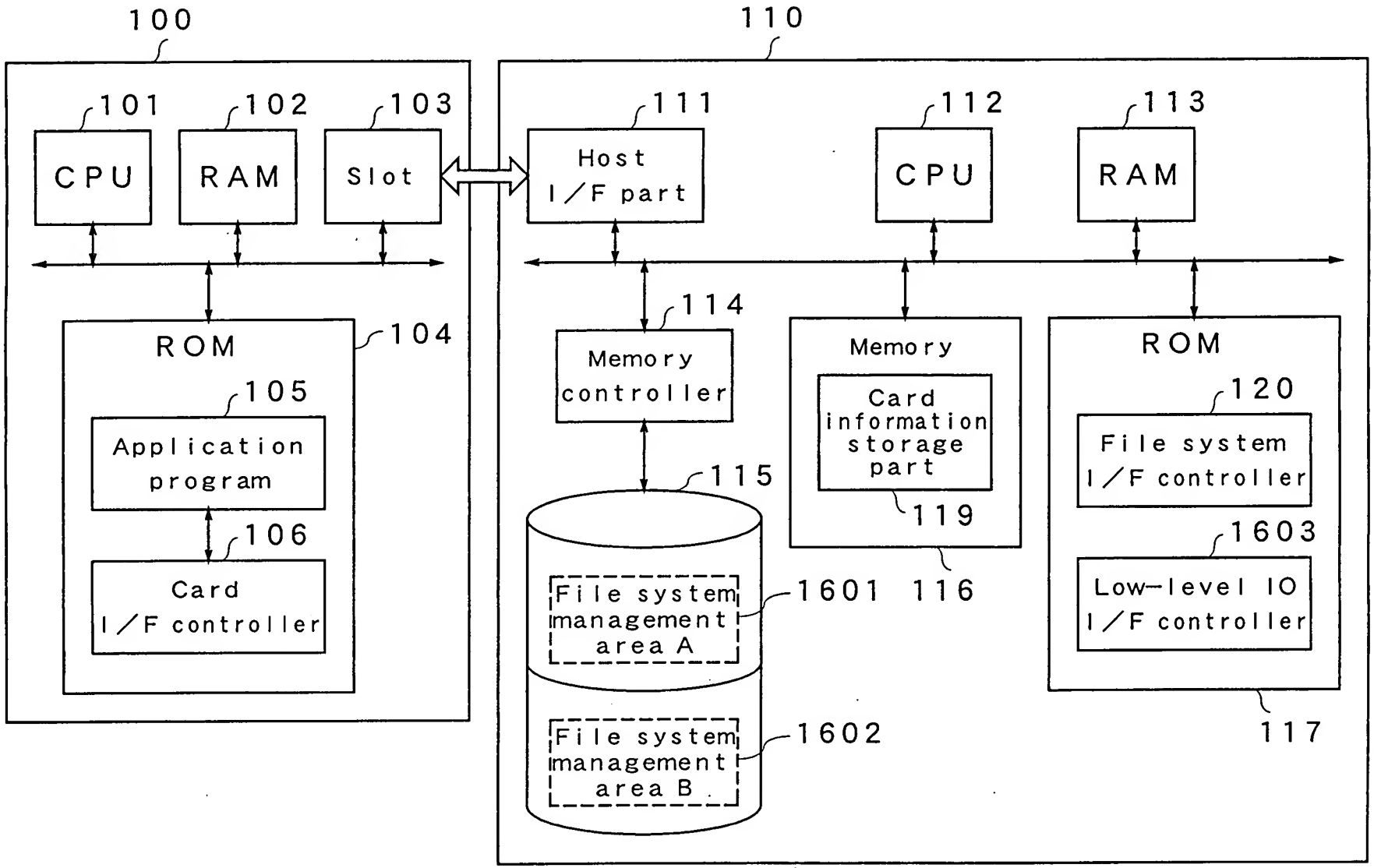

100
110
101
CPU
102
RAM
103
Slot
ROM
104
105
Application program
106
Card I/F controller
111
Host I/F part
112
CPU
113
RAM
114
Memory controller
115
File system management area A
1601
File system management area B
1602
Memory
Card information storage part
119
116
ROM
120
File system I/F controller
1603
Low-level IO I/F controller
117

FIG. 17

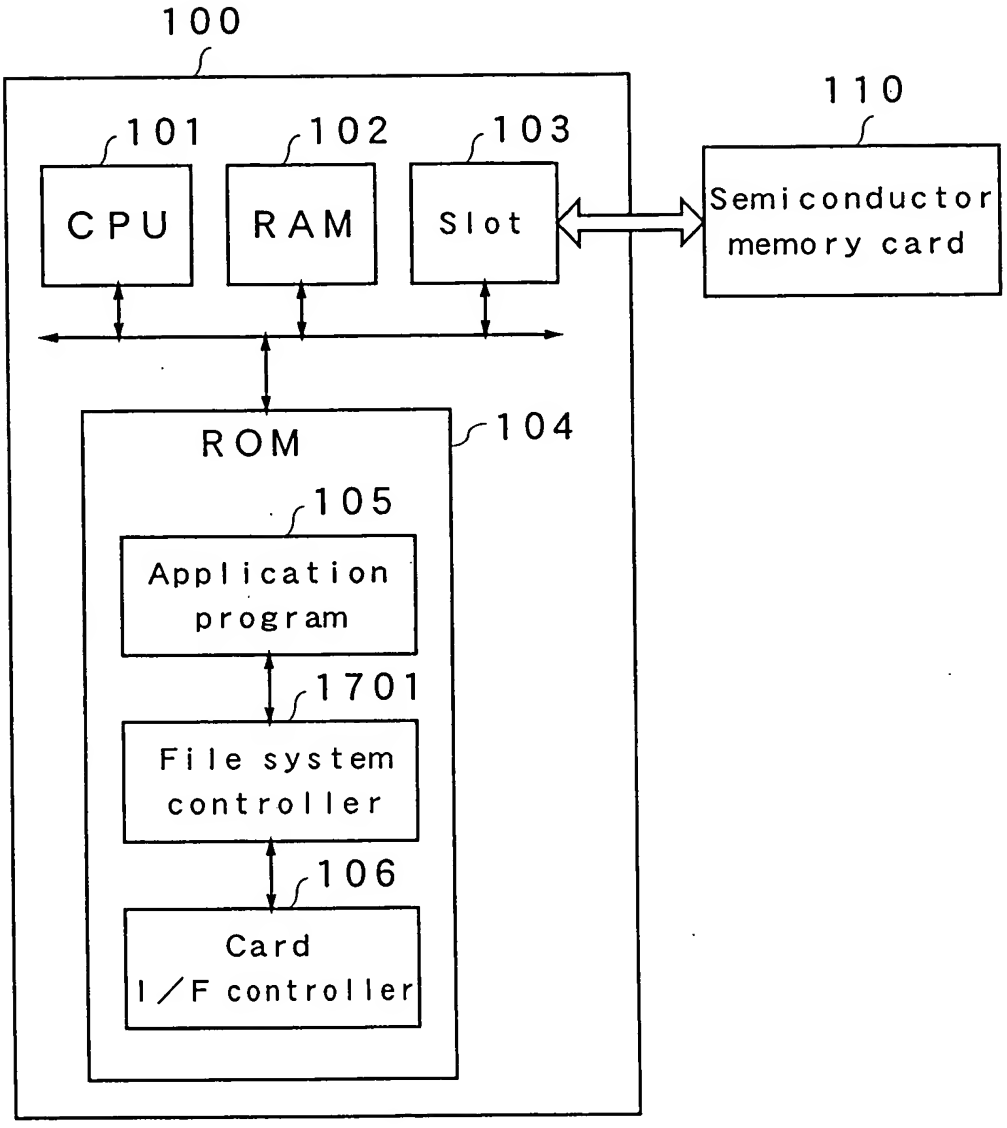

100
101
102
103
CPU
RAM
Slot
110
Semiconductor memory card
ROM
104
105
Application program
1701
File system controller
106
Card I/F controller

FIG. 18

Low-level IO API	Items
RAW_READ	Read data
RAW_WRITE	Write data
RAW_ERASE	Erase data

FIG. 19

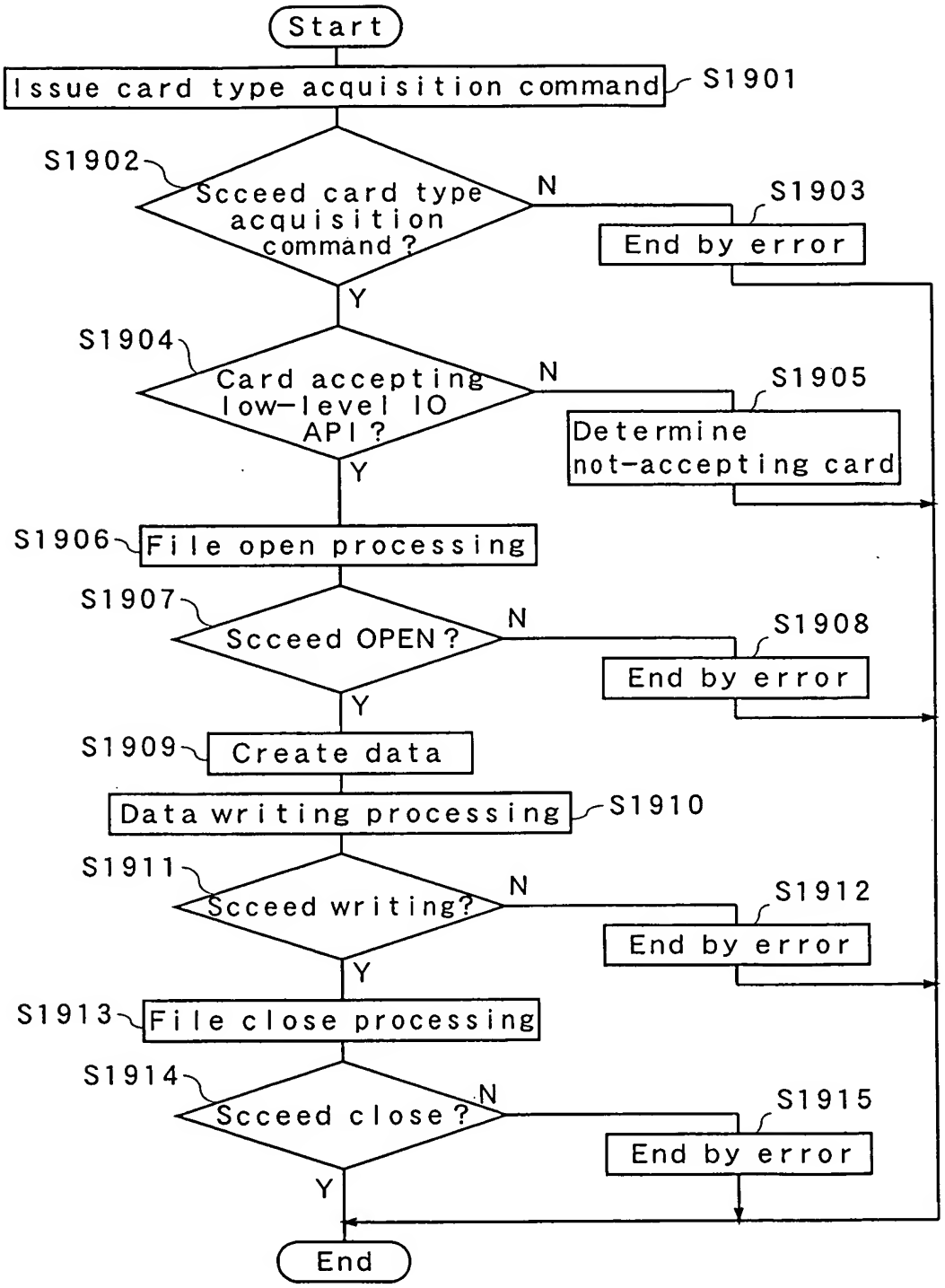

Start
Issue card type acquisition command
S1901
S1902
Scceed card type acquisition command?
N
S1903
End by error
Y
S1904
Card accepting low-level IO API?
N
S1905
Determine not-accepting card
Y
S1906
File open processing
S1907
Scceed OPEN?
N
S1908
End by error
Y
S1909
Create data
Data writing processing
S1910
S1911
Scceed writing?
N
S1912
End by error
Y
S1913
File close processing
S1914
Scceed close?
N
S1915
End by error
Y
End

FIG. 20

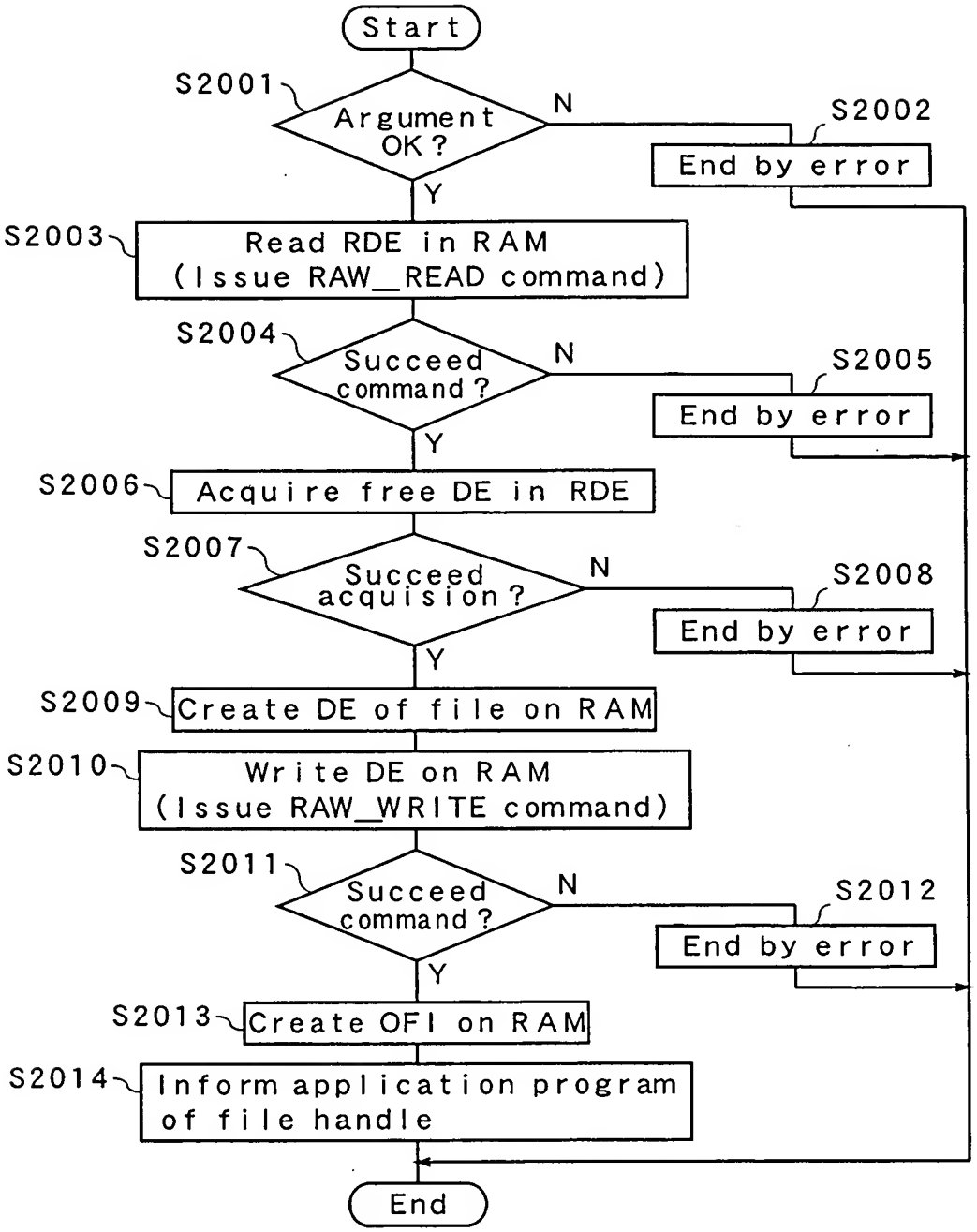

Start
S2001
Argument OK?
N
S2002
End by error
Y
S2003
Read RDE in RAM (Issue RAW_READ command)
S2004
Succeed command?
N
S2005
End by error
Y
S2006
Acquire free DE in RDE
S2007
Succeed acquision?
N
S2008
End by error
Y
S2009
Create DE of file on RAM
S2010
Write DE on RAM (Issue RAW_WRITE command)
S2011
Succeed command?
N
S2012
End by error
Y
S2013
Create OFI on RAM
S2014
Inform application program of file handle
End

FIG. 21

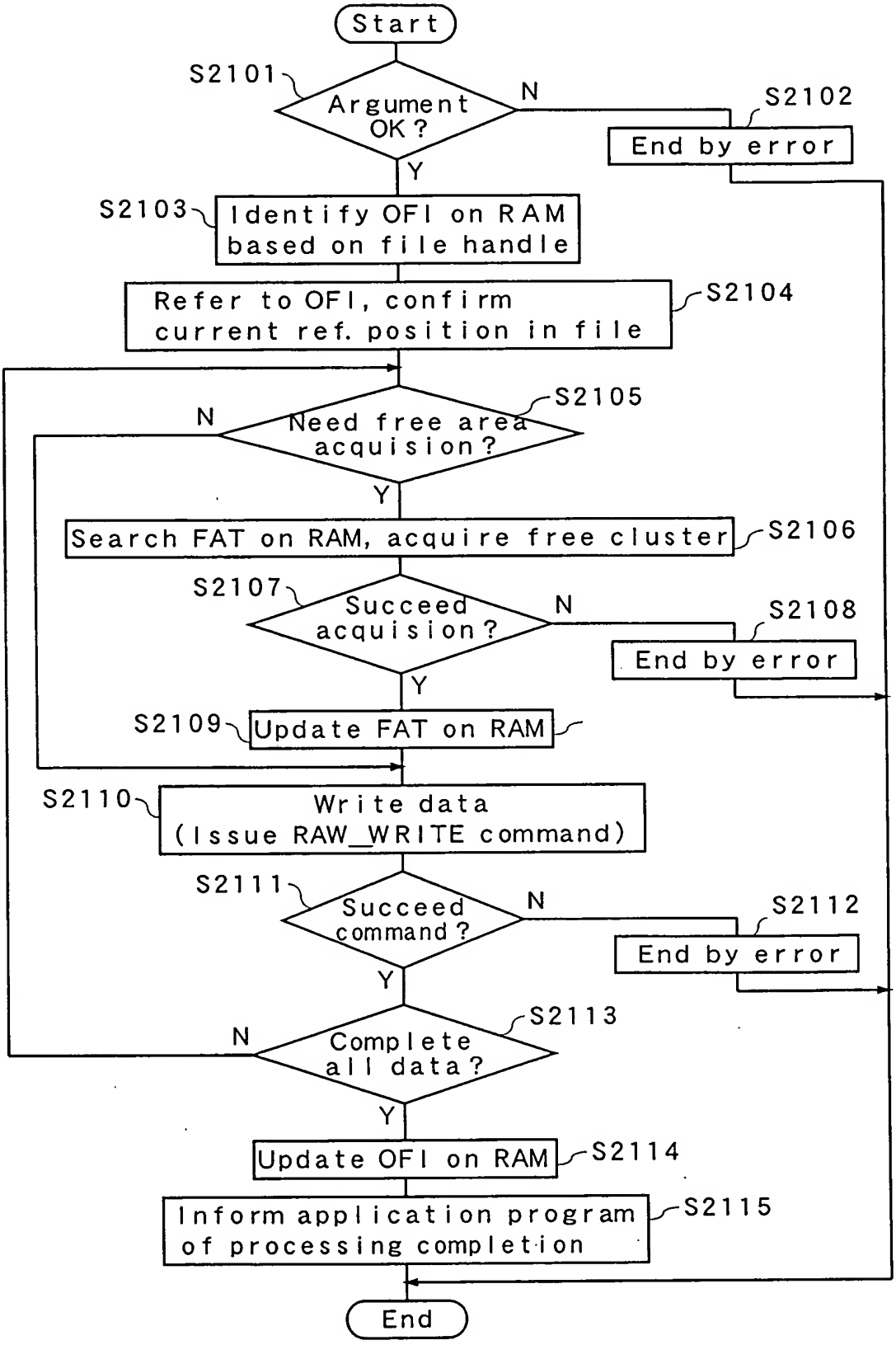

Start
S2101
Argument OK?
N
S2102
End by error
Y
S2103
Identify OFI on RAM based on file handle
Refer to OFI, confirm current ref. position in file
S2104
S2105
N
Need free area acquision?
Y
Search FAT on RAM, acquire free cluster
S2106
S2107
Succeed acquision?
N
S2108
End by error
Y
S2109
Update FAT on RAM
S2110
Write data (Issue RAW_WRITE command)
S2111
Succeed command?
N
S2112
End by error
Y
S2113
N
Complete all data?
Y
Update OFI on RAM
S2114
Inform application program of processing completion
S2115
End

FIG. 22

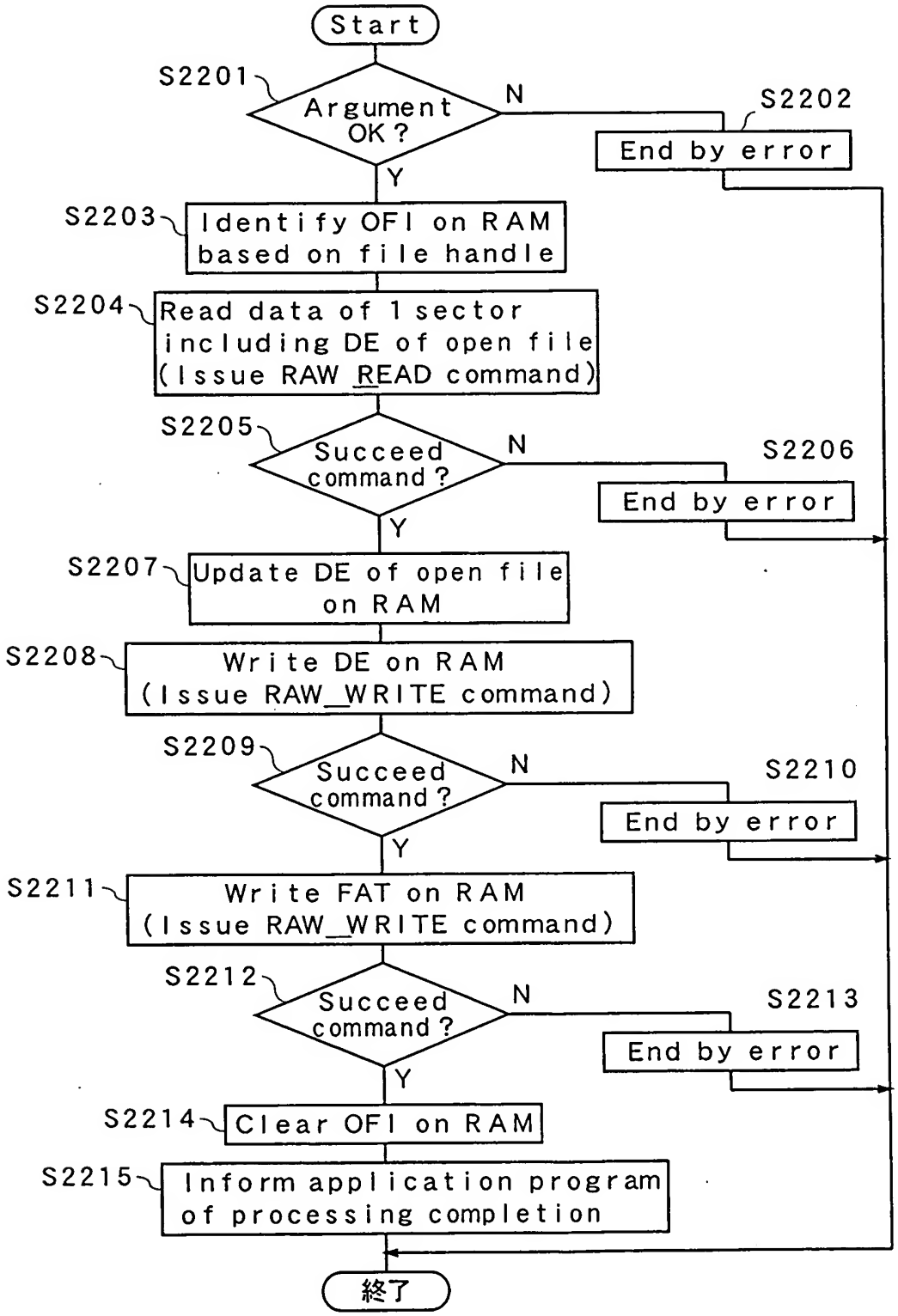

Start
S2201
Argument OK?
N
S2202
End by error
Y
S2203
Identify OFI on RAM based on file handle
S2204
Read data of 1 sector including DE of open file (Issue RAW_READ command)
S2205
Succeed command?
N
S2206
End by error
Y
S2207
Update DE of open file on RAM
S2208
Write DE on RAM (Issue RAW_WRITE command)
S2209
Succeed command?
N
S2210
End by error
Y
S2211
Write FAT on RAM (Issue RAW_WRITE command)
S2212
Succeed command?
N
S2213
End by error
Y
S2214
Clear OFI on RAM
S2215
Inform application program of processing completion
終了

FIG. 23

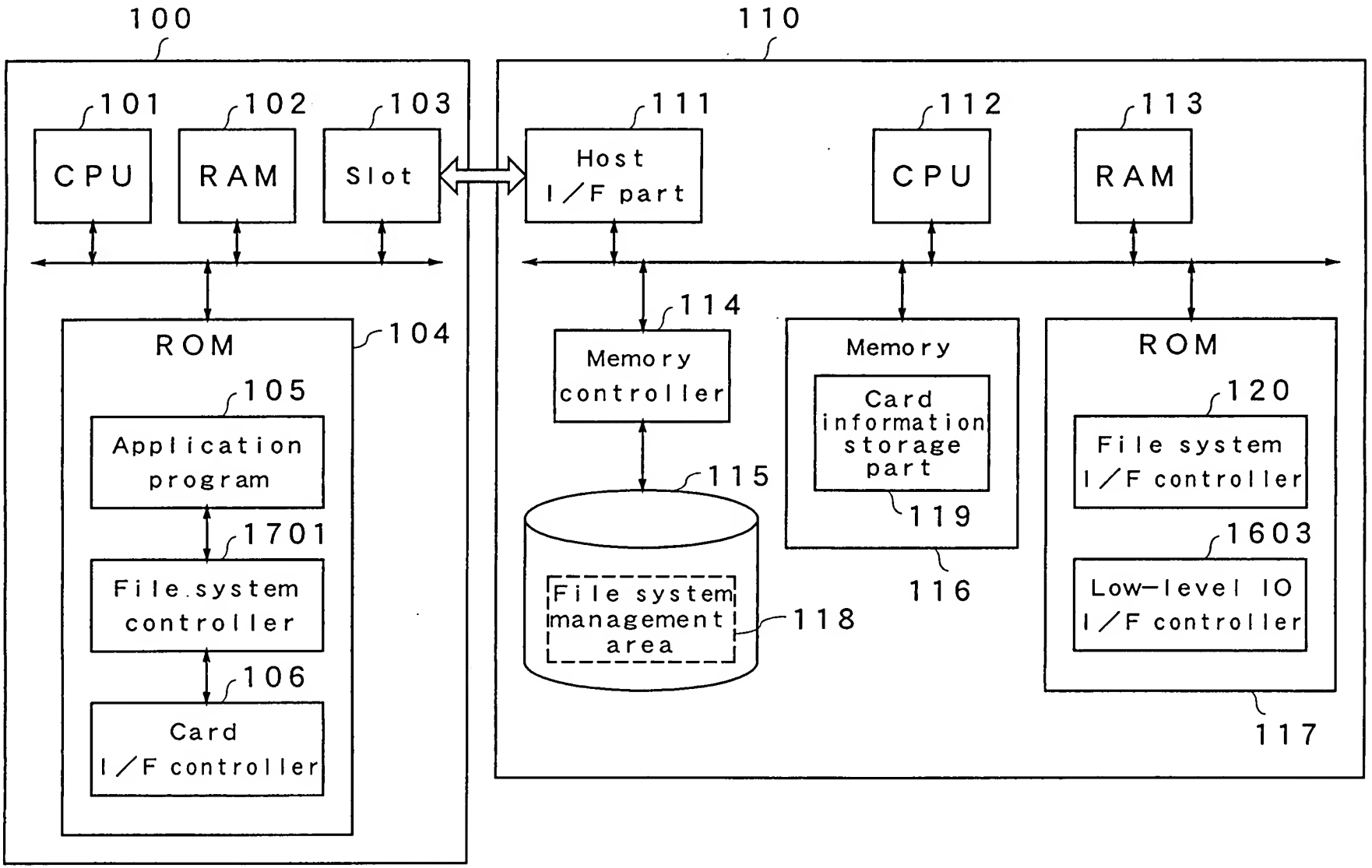

100
110
101
CPU
102
RAM
103
Slot
111
Host
I/F part
112
CPU
113
RAM
ROM
104
105
Application
program
1701
File system
controller
106
Card
I/F controller
114
Memory
controller
115
File system
management
area
118
Memory
Card
information
storage
part
119
116
ROM
120
File system
I/F controller
1603
Low-level IO
I/F controller
117

FIG. 24

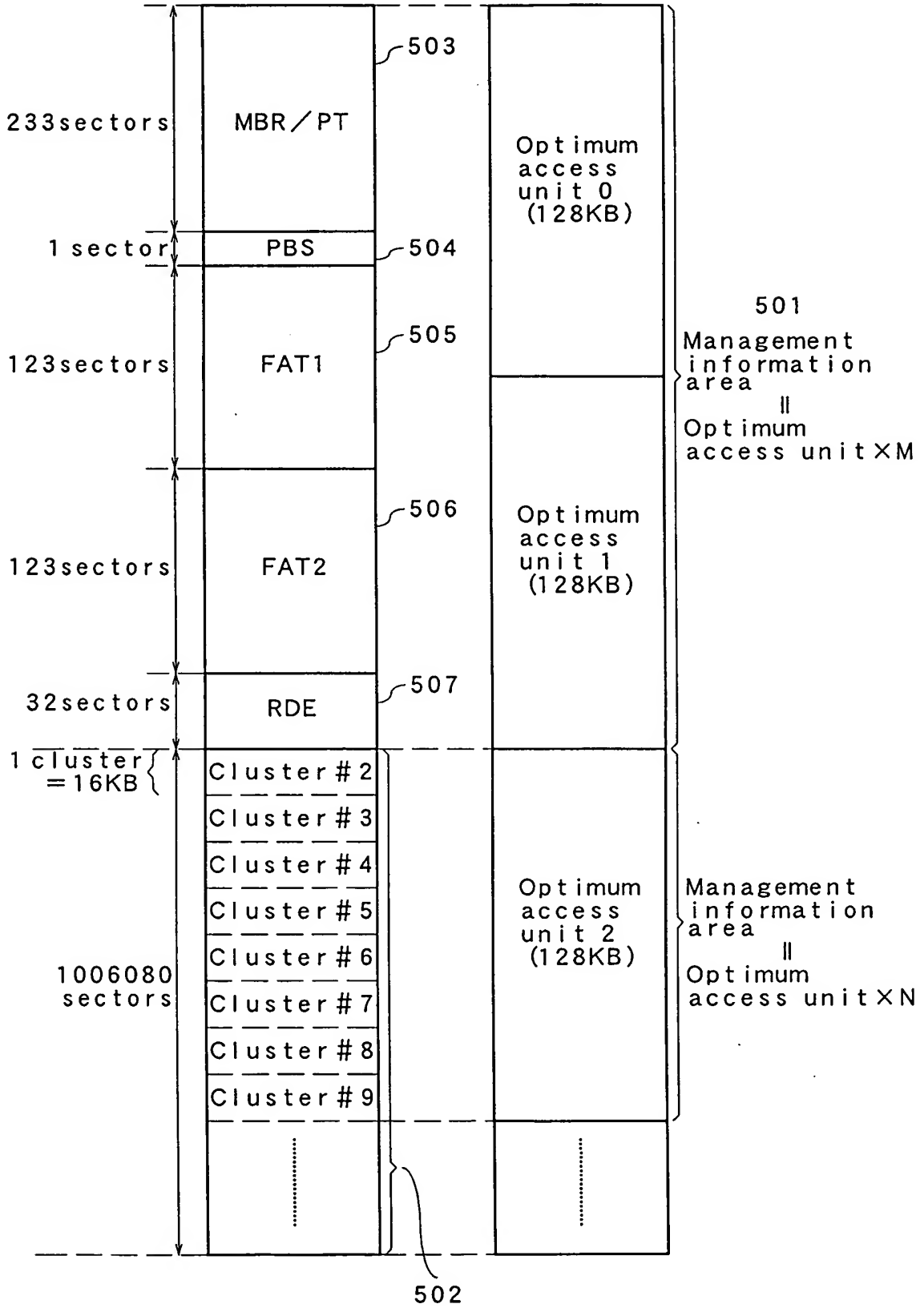

233sectors
MBR／PT
503
1 sector
PBS
504
123sectors
FAT1
505
123sectors
FAT2
506
32sectors
RDE
507
1 cluster
＝16KB
Cluster＃2
Cluster＃3
Cluster＃4
Cluster＃5
Cluster＃6
Cluster＃7
Cluster＃8
Cluster＃9
1006080
sectors
502
Optimum
access
unit 0
(128KB)
Optimum
access
unit 1
(128KB)
Optimum
access
unit 2
(128KB)
501
Management
information
area
‖
Optimum
access unit×M
Management
information
area
‖
Optimum
access unit×N

FIG. 25

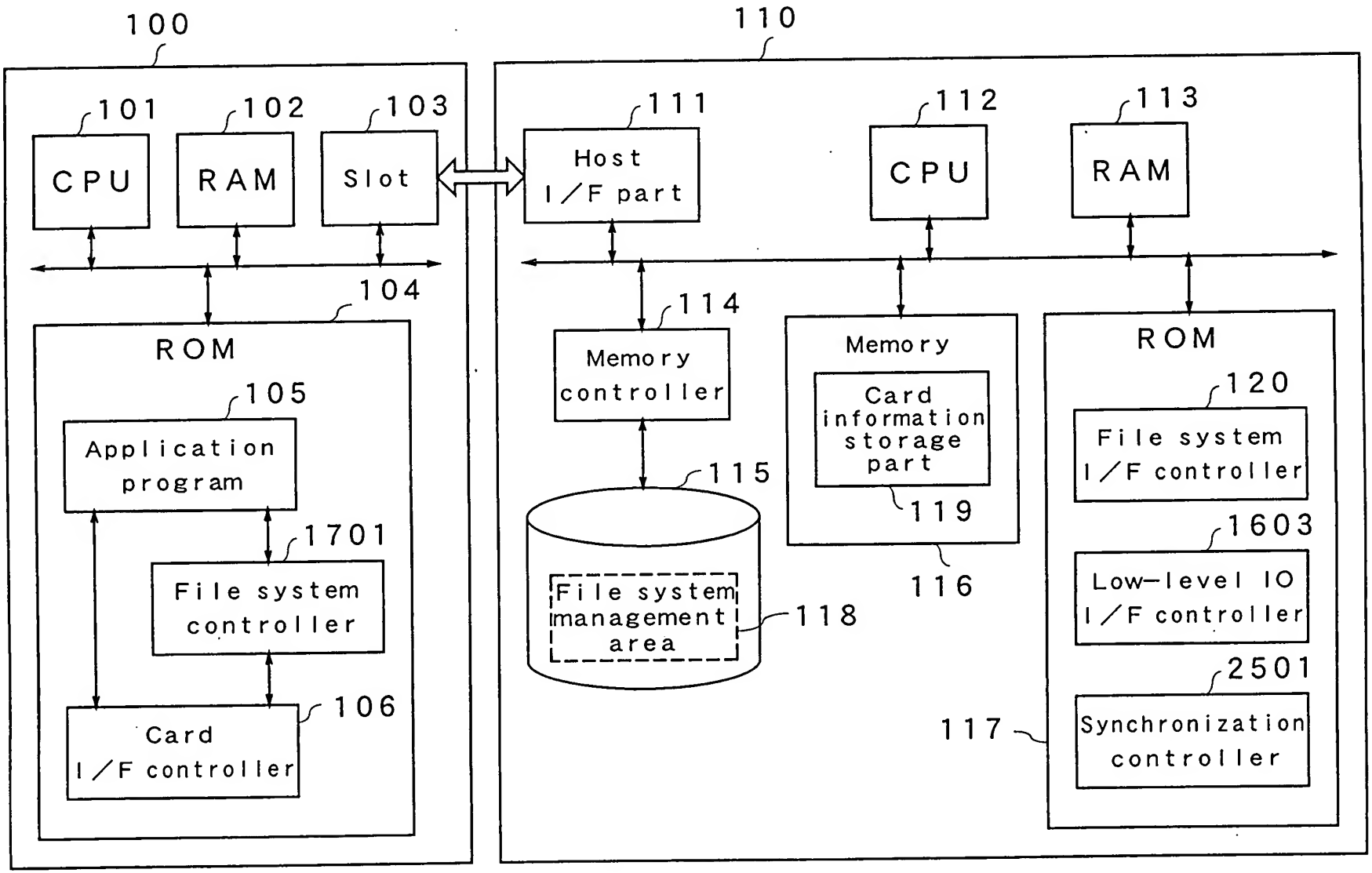

100
110
101
CPU
102
RAM
103
Slot
104
ROM
105
Application program
1701
File system controller
106
Card I/F controller
111
Host I/F part
112
CPU
113
RAM
114
Memory controller
115
File system management area
118
Memory
Card information storage part
119
116
ROM
120
File system I/F controller
1603
Low-level IO I/F controller
2501
Synchronization controller
117

FIG. 26

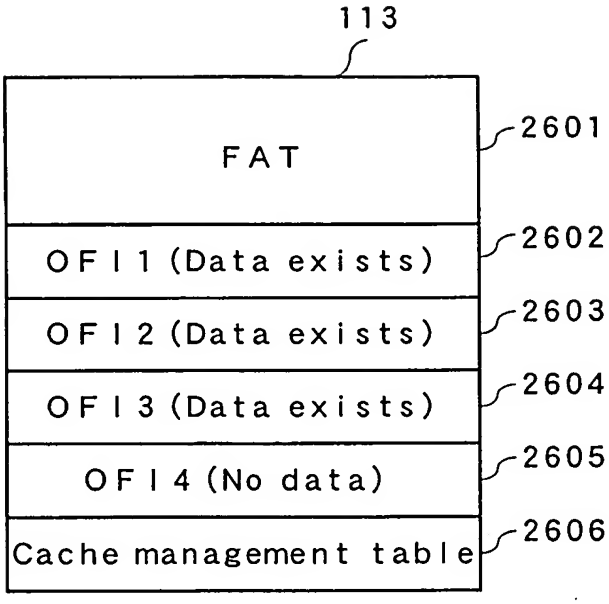


FIG. 27

2606

	Start sector no.	Size
FAT	234 sector	123sectors
Opened DE1	480 sector	1 sector
Opened DE2	480 sector	1 sector
Opened DE3	513 sector	1 sector
Opened DE4	0 sector	0 sector

FIG. 28

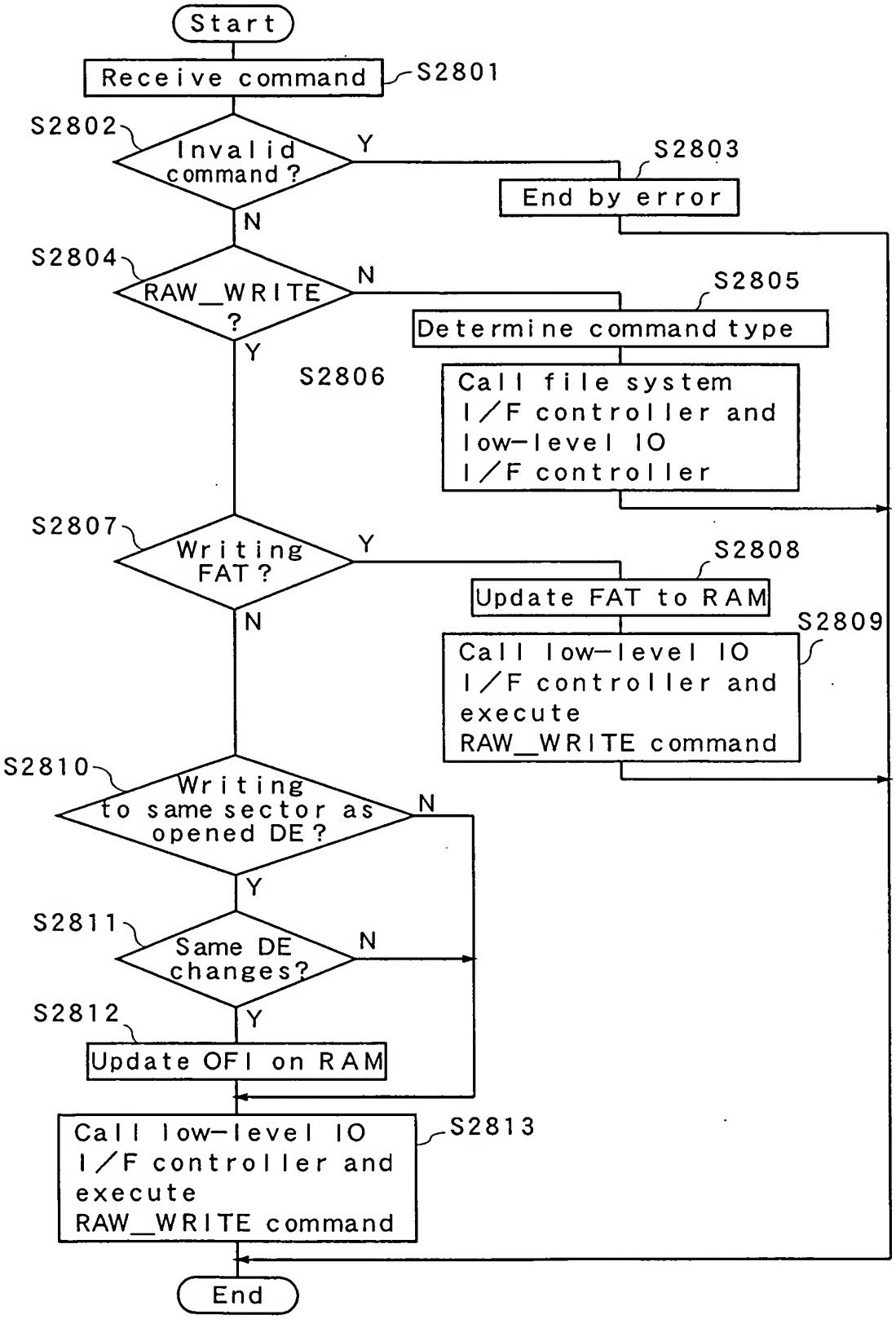

Start
Receive command
S2801
S2802
Invalid command?
Y
S2803
End by error
N
S2804
RAW_WRITE ?
N
S2805
Determine command type
Y
S2806
Call file system I/F controller and low-level IO I/F controller
S2807
Writing FAT?
Y
S2808
Update FAT to RAM
N
S2809
Call low-level IO I/F controller and execute RAW_WRITE command
S2810
Writing to same sector as opened DE?
N
Y
S2811
Same DE changes?
N
S2812
Y
Update OFI on RAM
Call low-level IO I/F controller and execute RAW_WRITE command
S2813
End

FIG. 29

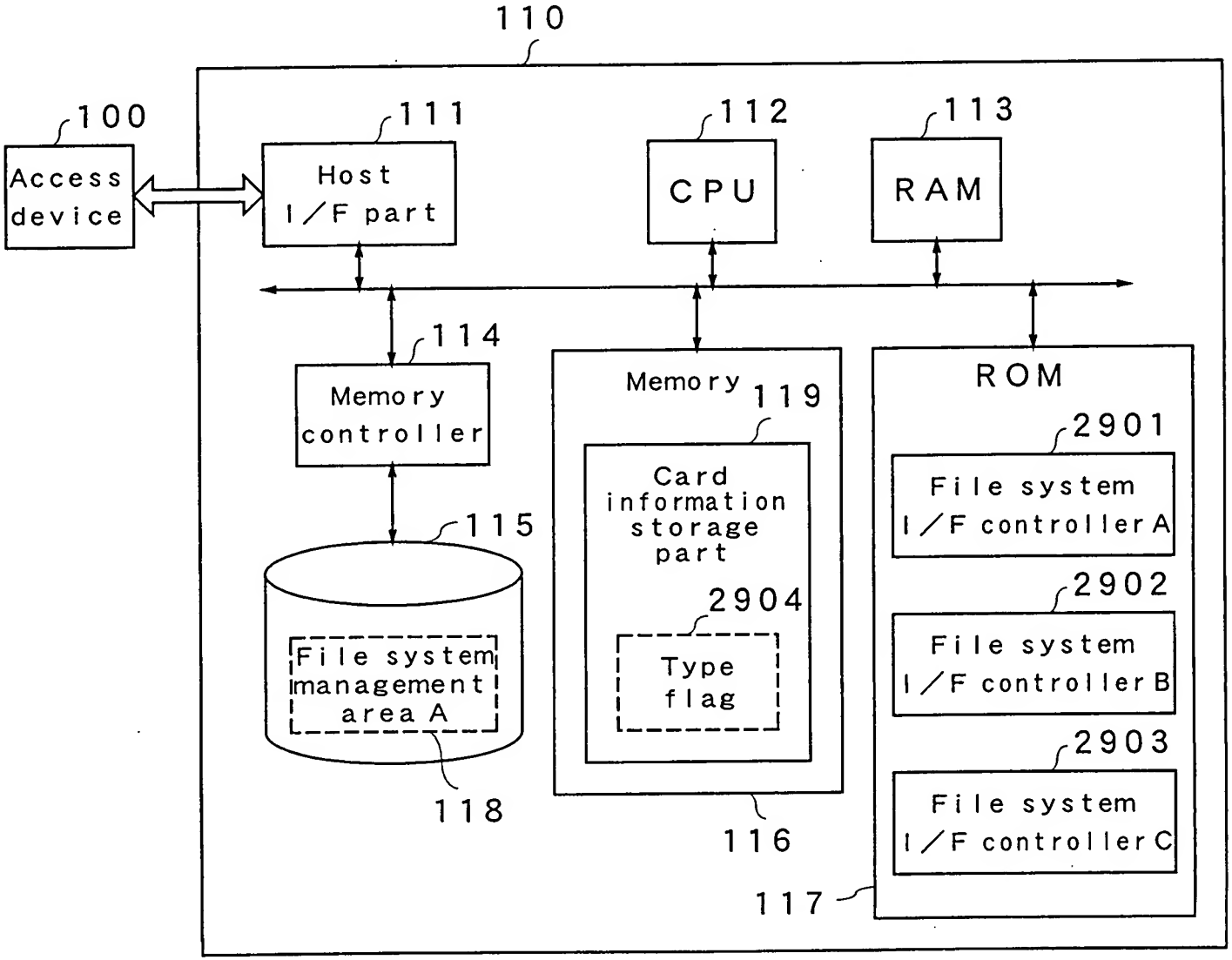
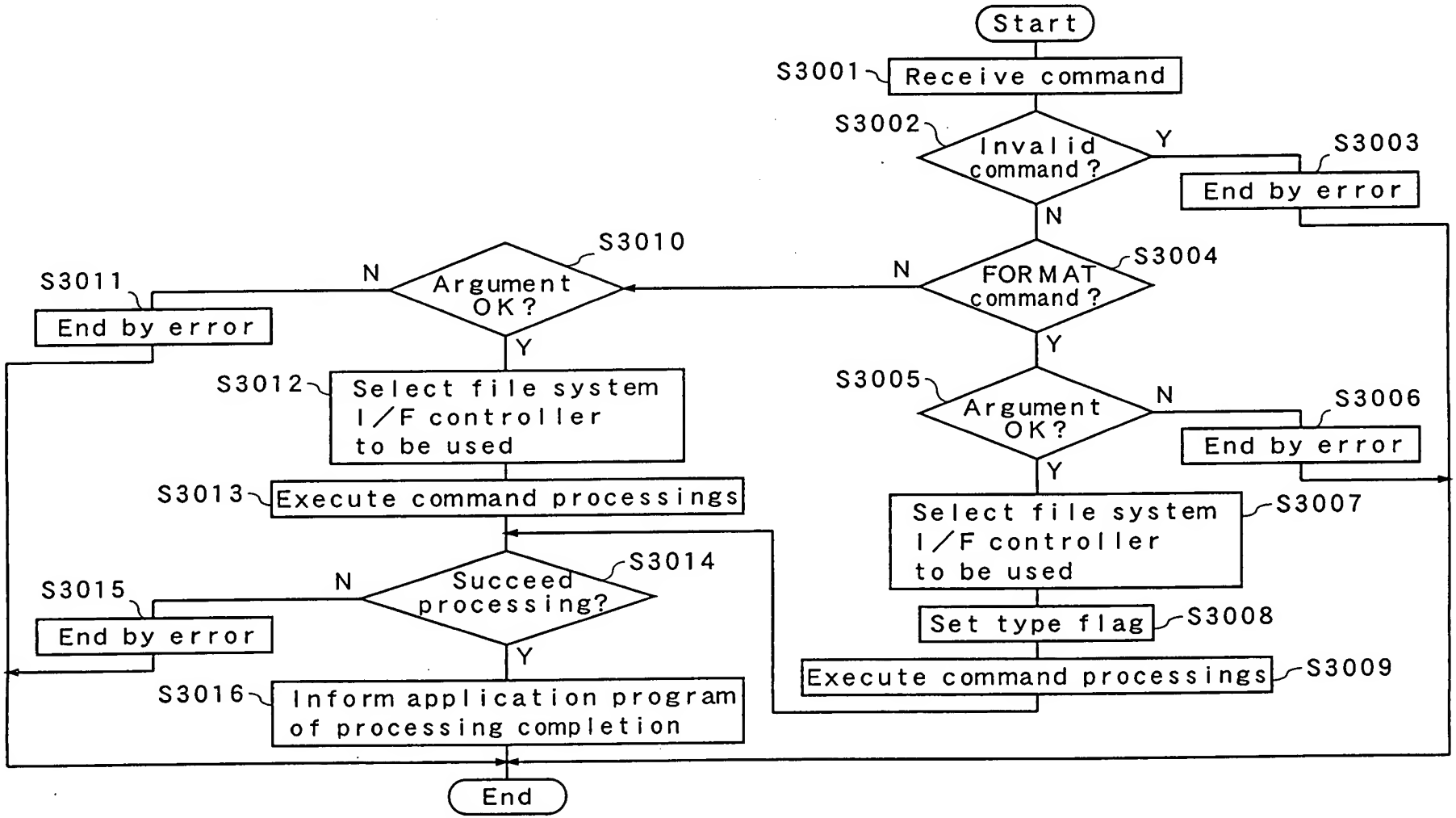

110
100
Access device
111
Host I/F part
112
CPU
113
RAM
114
Memory controller
115
File system management area A
118
Memory
119
Card information storage part
2904
Type flag
116
ROM
2901
File system I/F controller A
2902
File system I/F controller B
2903
File system I/F controller C
117

FIG. 30


Start
S3001
Receive command
S3002
Invalid command?
Y
S3003
End by error
N
S3004
FORMAT command?
N
S3010
Argument OK?
N
S3011
End by error
Y
S3012
Select file system I/F controller to be used
S3013
Execute command processings
S3014
Succeed processing?
N
S3015
End by error
Y
S3016
Inform application program of processing completion
Y
S3005
Argument OK?
N
S3006
End by error
Y
S3007
Select file system I/F controller to be used
S3008
Set type flag
S3009
Execute command processings
End